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SOLAR THERMAL POWER CONVERSION

As a means of providing heat, electricity, or both from the sun, JPL is developing parabolic dish solar collector technology under the Department of Energy's Solar Thermal Power Systems Project. JPL responsibility for solar point-focusing technology extends from subsystem development through testing of prototype modules, culminating in field experiments that lead to commercial systems for generation of electricity, process heat, or both. An important facet of the work takes place at the JPL parabolic dish test site (PDTS).

Prototype thermal receivers and power converters are to be tested on two test bed concentrators, each 11 meters in diameter, at the PDTS located at JPL's Edwards Test Station in the Mojave desert. Each concentrator uses 224 reflecting mirrors to focus the sun's rays. Optical energy conversion to heat occurs in a receiver at the focal point of the dish, where working fluids can be heated to temperatures, as needed, from about 370 to 1560 degrees Celsius.

To assess the performance of the concentrators, both as to their reflectivity and the geometric accuracy of their construction, the shape and intensity of the beam at the focal plane must be measured. A flux mapper and a cold water calorimeter were developed at JPL to measure these performance parameters. To facilitate the flux-mapping task, an absolute cavity-type radiometer was adapted to determine solar image intensity. These instruments are described below.

SOLAR CONCENTRATOR FLUX MAPPER

This instrument was designed for three-dimensional mapping of the intensity distribution of highly concentrated solar energy near the focus of an optical concentrator. Data obtained can be displayed as contour maps, digital arrays, and isometric visualization. The mapper is capable of measuring intensities up to 15,000 solar constants, using various radiometer probes which can be selected to provide the desired trade-off between speed of scanning and accuracy of measurement. (Solar constant is the quantity of radiant solar heat received normally at the outer layer of the Earth's atmosphere.)

The flux-mapping system consists of a radiometer sensor probe, a mechanism which moves this probe along three axes, electronics for recording electrical signals, and a microprocessor for controlling the probe. A photodiode probe is available for high-speed scanning of one inch per second, and is accurate to within 5 percent of the true value. With the JPL-designed cavity radiometer, a much slower scan is required but a measurement accuracy to within 1 percent can be achieved.

The flux mapper has successfully delineated flux patterns of both test bed concentrators and a third collector at the Edwards Test Station.

Figure (opposite page): The two 11-meter test bed concentrators, along with a 6-meter dish, are shown at the JPL parabolic dish test site at Edwards Test Station, where technology is being developed for DOE's Solar Thermal Power Systems Project.